OBITUARY NOTICES OF FELLOWS DECEASED.

HERMANN KOPP, who was elected a Foreign Member of the Royal Society in 1888, and who died in Heidelberg on February 20, 1892, was born on October 30, 1817, at Hanau, where his father, Johann Heinrich Kopp, practised with some distinction as a physician. The father occupied himself in his leisure with experimental chemistry, and a few papers by him on mineral analysis and on physiological chemical products are to be found in Leonhard's 'Taschenbuch' and Gehlen's 'Journal.' The subject of this notice received his school training at the gymnasium of his native town, where he was well grounded in Latin and Greek. The facility he thus acquired in reading classical literature never left him, and proved of incalculable service to him in the preparation of his great work on the history of chemistry. At eighteen he went to Heidelberg, where he studied chemistry under Leopold Gmelin and physics under Wilhelm Muncke. At that time Heidelberg presented few opportunities for acquiring a knowledge of practical chemistry. Gmelin was Ordinary Professor of Medicine as well as of Chemistry, and his chemical teaching was regarded as subordinate to that of medicine. Kopp left Heidelberg for Marburg, where he graduated in 1838, presenting to the Philosophical Faculty as his thesis an essay entitled 'De oxydorum densitatis calculo reperiendæ modo,' in which we trace the germs of the experimental work by which he is best known. From Marburg he passed on to Giessen, attracted thither by the growing fame of the chemical laboratory which Liebig had called into existence. Here he made, under Liebig's direction, the only investigation in pure chemistry that he ever published, an unimportant paper on the decomposition of mercaptan by nitric acid, for the most part a repetition of the work of Löwig and Weidmann on ethylsulphonic acid and its salts.

Kopp, however, elected to cast in his lot with that of Giessen, and in 1841 he became *Privat Docent* in that University, lecturing on theoretical chemistry, crystallography, meteorology, and physical geography. He now began, when barely twenty-four years of age, his celebrated 'History of Chemistry,' the work by which he is best known to the literary world. In 1843 he became Extraordinary Professor, and on the departure of Liebig to Munich in 1852 he and Heinrich Will were made Ordinary Professors, and were placed in charge of

the Giessen laboratory. This position he resigned after the first year, leaving Will the sole control of the laboratory. Kopp remained at Giessen nearly a quarter of a century, and all his most important experimental work was done there. In 1863 he received a call from Heidelberg, which he accepted, and here he stayed until his death, occupying himself with lectures on the history of chemistry and on chemical crystallography. He was repeatedly solicited to accept a position in one of the larger Universities, notably in Leipsig and in Berlin, but all attempts to draw him from his dear Ruperto-Carolina were fruitless. "Even Bunsen alone," he was wont to say, "keeps me fast in Heidelberg."

Kopp's 'History of Chemistry' is his greatest literary effort. The first volume of it appeared in 1843, and the fourth and final volume in 1847. By the publication of this classical work, Kopp, when barely thirty years of age, suddenly found himself famous. His life-long friend, von Hofmann, who was then at Giessen, has left us the following account of the sensation which the work made on its appearance:—

"With one accord his contemporaries recognised that here was a production which, whether they regarded the thoroughness of research that it displayed, or the manner in which the material resulting from that research was sifted and arranged, was without a parallel in the literature of any other country. And even to-day, after the lapse of nearly half a century, there is no historical work on chemistry that can be even remotely compared with it. Numbers of books relating to the same subject, some of considerable merit, have since been published in Germany and France, but it is not difficult to perceive that they are all grounded on Kopp's great work."

For upwards of forty years Kopp had it in contemplation to bring out a new edition, and much of the later historical work he published, such as his 'Beiträge zur Geschichte der Chemie,' which appeared between 1869 and 1875, and the 'Entwicklung der Chemie in der neueren Zeit,' printed under the auspices of the Historical Commission of the Bavarian Academy in 1873, together with the two volumes on 'Die Alchemie in älterer und neuerer Zeit,' grew out of the materials he had gathered together. "But," again to quote Hofmann, "the better is here the enemy of the good. Kopp postponed the 'vermehrte und verbesserte Auflage' year after year, in the hope of being able to make a fuller study of certain special periods. Whoever is familiar with the mass of profoundly interesting matter he had accumulated, or who has had the opportunity of seeing the bulky note-books in which it was stored, must deeply lament that the hand which could alone arrange these treasures is now stiffened in death."

The literature of chemistry is further indebted to Kopp for the

part he played in the foundation and execution of the well-known 'Jahresbericht über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaften.' This great work was, in a sense, the outcome and continuation of Berzelius' 'Yearbook.' On the death of the Swedish chemist in 1848, the leaders of the Giessen school of chemical thought determined to carry on his work of registering the progress of chemistry, but on a somewhat different plan. Berzelius at the time of his death was the greatest chemical critic of the time, and wielded his authority with all the despotism of an Oriental potentate. The 'Jahresbericht' of Liebig and Kopp differed fundamentally both in plan and execution from its Swedish prototype. It was to be a review of the year's progress, not only in chemistry, but also in all those sciences which were associated with chemistry, or were, in any definite sense, ancillary to it; it was to be done impartially, and with no special reference to any set of dogmas or particular school of chemical thought. Practically the whole of the more active members of the scientific side of the Philosophical Faculty of the University were concerned in its production. To Kopp fell the greater share of the arrangement, and of the general editorial management; in addition, he undertook the summaries relating to Theoretical, Physical, and Inorganic Chemistry. To Buff and Zamminer was entrusted Pure Physics; to Heinrich Will, Organic Chemistry; to Knapp, Technical Chemistry; to Ettling, Mineralogy; and to Dieffenbach, Chemical Geology. The first volume appeared towards the close of 1849, and consisted of a review of the work of 1847 and 1848. Liebig continued to be associated with Kopp as editor for some years after his removal to Munich, but in 1857 his place was taken by Will, who acted as co-editor until 1862, when Kopp resigned his share in the responsible direction of the publication just prior to his removal to Heidelberg. No chemist active in the prosecution of research needs to be reminded of the value of the 'Jahresbericht.' It has undoubtedly exercised a most beneficient influence on the development of chemical science in Germany, and it has been of the greatest service to those chemists in this country to whom German is not an unknown tongue.

In 1851 Kopp joined Liebig and Wöhler in the production of the 'Annalen der Chemie und Pharmacie,' and for many years he took the responsible share in its management. He prepared the section on "Theoretical Chemistry" in that well-known text-book, Graham-Otto's 'Lehrbuch der Chemie' and his 'Introduction to Crystallography,' written specially for chemists, was long a standard work.

Kopp's scientific papers relating to his experimental and critical labours appeared mainly in 'Poggendorff's Annalen,' and in the 'Annalen der Chemie und Pharmacie.' Two or three of his early communications were printed in the 'Philosophical Magazine,' and

his elaborate memoir, "On the Specific Heat of Compound Substances," in which he sought to develop Neumann's law, was published by the Royal Society. The 'Royal Society Catalogue of Scientific Papers' gives the number of his papers as 65.

Kopp enjoys an almost unique position as an investigator. The one consistent purpose of his work was to establish a connexion between the physical and chemical nature of substances; to prove, in fact, that all physical constants are to be regarded as functions of the chemical nature of molecules. It is not implied, of course, that the conception of such an interdependence originated with him. As a matter of fact, almost immediately after the publication of Dalton's 'New System of Chemical Philosophy,' in which the doctrine of atoms was revived to account for the fundamental facts of chemical union, the endeavour was made to connect the chemical attributes of a substance with one of its best defined physical constants, viz., its atomic mass. Prout's hypothesis is, in reality, the generalised expression of such an attempt; it is an adumbration of Mendeléeff's great discovery of the Law of Periodicity. But it may be justly claimed for Kopp that no one before him made any systematic effort to connect such of the physical qualities of substances as admit of quantitative statement with the stoichiometrical values of such bodies. The sporadic attempts made prior to 1840 were practically fruitless on account of the imperfect nature of the physical data up to that time extant.

When Kopp began his inquiries, very few boiling points were known, even approximately; and he had, as a preliminary step, to ascertain the conditions under which such observations must be made in order that accurate and comparable results could be obtained. The thermal expansions of barely half a dozen liquids had been measured, and the very methods of making such measurements with precision had to be worked out.

At the outset of his investigations, Kopp found the physical constants with which he was more immediately concerned very much as Berzelius found Dalton's values of the relative weights of the atoms; at the close of his work they were hardly less accurately known than were those stoichiometric numbers to the ascertainment of which the great Swedish chemist had dedicated his life.

Kopp's more important memoirs readily and naturally fall into comparatively few groups, viz., (1) those concerning the relations between the specific gravities of substances and their molecular weights; (2) those treating of the relations between boiling point and chemical composition; and (3) the papers relating to the specific heats of solids and liquids. As regards the other papers, only the briefest notice is here possible. Much of this work was of a pioneer character, and his conclusions have necessarily been modified by

subsequent research. His "law" of boiling points is no longer regarded as an accurate expression of experimental facts, and his deductions with respect to specific volumes have been largely affected by subsequent work. It has been conclusively shown that molecular volume is not a purely additive property. There is no longer room for doubt that the molecular volumes of substances are affected by far more conditions than Kopp was able to take cognisance of.

The value $CH_2 = 22$ has no other significance than as expressing the average increment in volume in successive members of a homologous series. Indeed, as the physical data increase, it becomes doubtful whether even this mean value is correct. Later observations appear to show that the value augments as the series is ascended. The relation $C = 2H$ no longer applies to carbon compounds in general. What is true of carbon and hydrogen is equally true of oxygen, whether as carbonyl- or as hydroxyl-oxygen. No definite or uniform values can be assigned to oxygen such that the molecular volume of a liquid can be *a priori* determined. The values given by Kopp are simply mean values, but the actual volumes are affected by conditions of which, as yet, we have no very precise knowledge or any certain means of measuring. The values for the other elements are, of course, affected by these considerations. Thus the specific volume of chlorine is obtained on the assumption that the values for carbon and hydrogen are constant. All, then, tends to show that the molecular volume is not the sum of constant atomic volumes.

Although Kopp's theoretical conclusions hardly admit of the generality which he assumed them to possess, his experimental work remains unassailed and unassailable, a monument to his ingenuity, manipulative skill, his rigid sense of accuracy, and illimitable patience.

T. E. T.

Dr. John Rae, LL.D. (Edin.), a traveller in Arctic America, of extraordinary energy and endurance, a keen observer of Nature, and the discoverer of the fate of the Franklin expedition, was born in Orkney in 1813, died in London in 1893, and is buried in the cathedral of St. Magnus at Kirkwall, where a statue is erected to his memory.

He qualified as a surgeon in Edinburgh, and as such he accompanied one of the ships of the Hudson's Bay Company, whose service he joined, and then for ten years he resided at Moose Factory. (1) His first journey of pure exploration was a boat voyage along the coast of Hudson's Bay to Repulse Bay, where he wintered, and, in the following year he surveyed a coast line of 700 miles, connecting the surveys of Ross in Boothia with those of Parry at Fury and Heckla Strait. (2) Next he joined the expedition of Sir J. Richard

son in 1848 in search for Sir J. Franklin, during which the whole coast was explored that lay between the mouths of the Mackenzie and the Coppermine Rivers. (3) In 1851, at the request of Government, he explored and mapped, with the slenderest outfit, 700 miles of the south coast of Wollaston Land and Victoria Land, still in search of Sir J. Franklin, for which achievement he received the gold medal of the Geographical Society. Its result was greatly to narrow the range of possibilities as to the locality of the missing expedition. (4) He took charge of a boat expedition, proved the insular character of King William's Land, and came at last upon relics of Franklin's party and received verbal information from the Eskimo that gave the first definite information as to their fate. The disaster occurred at the mouth of the Back River, a little more than 200 miles in a direct line from the place where he heard of it. For this achievement he received the promised grant of £10,000 from Government. He did not visit the spot himself, but his information as to the site and the completeness of the disaster, was soon abundantly confirmed. After this he made some further travel of interest, though by no means of the importance of the above, surveying a route for a telegraph line across Iceland and in North America.

This bald statement of itineraries will give but a poor idea, except to Arctic travellers, of the severity of the work accomplished. To supply the deficiency, the following quotation is given from the address of Sir R. Murchison when presenting the Gold Medal to Dr. Rae; his remarks chiefly referring to the journeys numbered above as (1) and (3).

"With a boldness never surpassed, he (Dr. Rae) determined on wintering on the proverbially desolate shores of Repulse Bay, where, or in the immediate neighbourhood, one expedition of two ships had previously wholly perished, and two others were all but lost. There he maintained his party on deer shot principally by himself, and spent ten months of an Arctic winter in a hut of stones, the locality not even yielding drift timber. With no other fuel than a kind of hay made of the *Andromeda tetragona*, he preserved his men in health, and thus enabled them to execute their arduous surveying journeys of upwards of 1,000 miles round Committee Bay (the southern portion of Boothia Gulf) in the spring. Next season he brought his party back to the Hudson Bay posts in better working condition than when he set out, and with but a small diminution of the few bags of provisions he had taken with him.

"On his last journeys, in which he travelled more than 3,000 miles in snow-shoes, Dr. Rae has shown equal judgment and perseverance. Dreading, from his former experience, that the sea might be frozen, he determined on a spring journey over the ice, and performed a most extraordinary one. His last starting place at Fort Confidence on the

Great Bear Lake, being at a distance of more than 150 miles from the coast by the route he was compelled to take, he could not, as in the parties of our naval expeditions, travel on the ice with capacious sledges, and was, therefore, obliged to restrict his provisions and baggage to the smallest possible weight. With a pound of fat daily for fuel, and without the possibility of carrying a tent, he set out accompanied by two men only, and trusting solely for shelter to snow houses he taught his men to build, accomplished a distance of 1,060 miles in 39 days, or 27 miles per day including stoppages, and this without the aid of advanced depôts, and dragging a sledge himself great part of the way. The spring journey, and that which followed in the summer in boats, during which 1,700 miles were traversed in 80 days, have proved the continuity of Wollaston and Victoria lands along a distance of nearly 1,100 miles, and have shown that they are separated by a strait from N. Somerset and Boothia, through which the flood tide sets from the north. In this way Dr. Rae has performed most essential service, even in reference to the search after Franklin, by limiting the channels of outlet between the continent of America and the Arctic Islands."

It is easy to understand that Dr. Rae's views as to the equipment of expeditions in Arctic travel would differ in many respects, rightly or wrongly, from those who advocated the costly naval expeditions then in vogue. He could point to instances of his own superior success, and to the disasters that befel the survivors of the Franklin expedition, as they toiled homewards with a miscellaneous collection of heavy articles. Putting forward his views, as he did with point and insistence, his remarks were, as a rule, somewhat unwelcome to the naval authorities.

In early middle life Dr. Rae was remarkable for manly beauty in form and feature, combined with a temper that was quick and somewhat fiery. In a book on Ethnology, where each of the human races was represented by a single specimen, it was noticed that an old photograph of Dr. Rae had been utilised to represent the Caucasian type.

Dr. Rae's house contained an interesting series of specimens illustrating the fauna and flora of arctic America and the domestic methods of the Eskimo, which he delighted to show and to explain, for he was a most courteous host, well aided by his wife. As a narrator he was delightful, being always lucid while full and circumstantial. His memoirs and speeches were stamped throughout with those characteristics.

His interest in the regions where he gained his fame remained unabated to the last. He died, regretted by many friends, in his eightieth year.

F. G

FRANZ ERNST NEUMANN was born on September 11, 1798, at Joachimsthal, a small town about forty miles to the north-east of Berlin. At the early age of seventeen he entered the army as a volunteer to fight against Napoleon in the campaign of 1815. A serious wound, received in the battle of Ligny, kept him to his bed for many weeks; but, on recovery, he once more joined the army. At the end of the war he returned to his lessons at the "Gymnasium" of Berlin, and subsequently entered the University as a student of theology. Soon afterwards he migrated to Jena, where he came under the influence of C. S. Weiss, the Professor of Mineralogy, and turned his attention to that subject. His papers, published between 1823 and 1830, all referred to crystallography, and even his earliest work attracted attention, and left a lasting impression on the science of mineralogy. It secured him a call to the University of Königsberg as "Privat-docent," where Bessel, Jacobi, and Dove became his colleagues. Under their influence he gradually drifted more and more towards the study of physics. His knowledge of mathematics was acquired by private study, for although the University of Berlin nominally possessed a teacher of mathematics, no lectures were given. If the circumstances of Neumann's early education are considered, it is remarkable that he obtained such a command of mathematical physics, and this seems to have been ascribed by himself to the careful study of Fourier's writings, which he admired to such an extent that he made a manuscript copy of the great treatise on the 'Conduction of Heat.' In the year 1828 Neumann was appointed Professor Extraordinarius at a salary of 200 thalers (£30). Bessel, who had formed a high opinion of his powers, wrote in the same year a letter to the Minister of Education pressing Neumann's claim to a better position. The letter had the desired effect, and Neumann was nominated, in 1829, Professor Ordinarius, and his salary raised to £75. He never left Königsberg, continuing his professorial duties until 1876, and died on May 23, 1895.

Among his earlier papers on physical subjects, attention must be drawn to one on the specific heat of minerals (*Pogg. Ann.*, 1831). It contains an extension of Dulong and Petit's law of specific heats to compound bodies having a similar chemical constitution, but is chiefly valuable for the improvement, both in the methods employed and in the theoretical discussion of the experimental results. It is shown how the method of mixture may be applied to the case of badly conducting substances. The second paper treats of the specific heat of water. The older observers had stated that when hot water is poured into cold water, the resulting temperature of the mixture is lower than that calculated, on the assumption that the specific heat of water is constant. Neumann showed that this result is due to errors of experimentation, and demonstrated with

improved apparatus, that the specific heat of water increases with rising temperature. On the assumption that the rate of change is uniform, Neumann calculated the ratio of the specific heats at 100° and 0° to be 1·0176. The assumption made is now known to be incorrect, but it cannot be said that Neumann's experimental result has been much improved upon by later investigators. Although nearly all fields of physical science have at different times been successfully treated by Neumann, his fame chiefly rests on his theoretical investigations in optics and electricity. After Fresnel's fundamental researches, which had shown the possibility of explaining the most complicated optical phenomena by the undulatory theory, it became necessary to connect that theory more closely with the conditions of wave-propagation in ordinary elastic bodies. In other words, an elastic solid theory of the ether formed the next step to be taken, and the name of Neumann will always remain associated together with that of Cauchy, McCullagh, and Green in the early efforts to found a truly dynamical theory of light. In the first paper, "Theorie der doppelten Strahlenbrechung abgeleitet aus den Gleichungen der Mechanik," Neumann obtains a wave-surface identical with that deduced somewhat earlier by Cauchy. In the case of biaxal crystals it does not agree with that of Fresnel. It consists of three sheets, one of them being due to the longitudinal wave. The difference of the two other sheets with Fresnel's surface is, however, more nominal than real, for as Stokes pointed out, in his Report on Double Refraction, the difference may, by proper adjustment of the constants, be made to show itself only in the tenth place of decimals. The same report gives full details on the comparison between the theories of Cauchy, Neumann and Green. A further important contribution to optics was made in the year 1835 under the title "Theoretische Untersuchungen der Gesetze, nach welchen das Licht an der Grenze zweier vollkommen durchsichtigen Medien reflectirt und gebrochen wird." This paper raises the difficult question of the mathematical expression for the conditions which must hold at the surface separating two crystalline media. For well considered reasons Neumann adopts the view that the density of the ether is the same in all media, and follows out this hypothesis to its logical consequences. The same problem was treated at the same time by McCullagh by very different and simpler methods, but the results of both investigators were identical. Neumann further confirmed his equations by experiment. The general acceptance of the electromagnetic theory has now considerably changed our point of view, but the historical importance of Neumann's work must be conceded in spite of certain defects which may, with justice, be urged against it.

Several further papers treated of optical subjects, amongst which,

perhaps, the most important refers to double refraction in strained uncrystalline bodies.

Neumann* next turned his attention to electricity, and in two important papers, published in 1845 and 1847, established the laws of induction of electrical currents. We meet here, for the first time, with the "electrodynamic potential." It is shown how currents, induced in one circuit either by the motion of conductors carrying electric currents, or by a change in the intensity of the current, may be deduced from one function depending on the relative position of the conductors, and that this function will also determine the mechanical forces acting between the conductors. To appreciate fully the great advance which was made by these two memoirs, it is necessary to realise that the papers were published before it had been shown, by Helmholtz and Lord Kelvin, how the principle of the conservation of energy may be utilised in the treatment of the problem. It may also be pointed out that Neumann's investigations are deduced from Lenz' laws, which are direct consequences of the principle of energy; so that Neumann's treatment may, indirectly, be said to depend on that principle.

Neumann was the first to solve the problem of the magnetisation induced in an ellipsoid of revolution under the action of any magnetic forces. Other important contributions relate to the functions known as spherical harmonics. It is a matter for regret that his first paper on that subject ('Astronomische Nachrichten,' 1838) was completely overlooked by magneticians until Ad. Schmidt recently drew attention to it. The method which might with great advantage have been employed in the treatment of terrestrial magnetism, may be explained by reference to the simpler problem of expanding a function of one variable by means of Fourier's series. For instance, if the daily changes of temperature are to be expressed in such a series from hourly readings of the thermometers, a very simple and well-known process leads to the determination of the constants. Neumann's investigations led him to an analogous process for the expansion of a function in a series of spherical harmonics, the functions having known values at the points of intersection of certain latitude and longitude circles on a sphere.†

Neumann's last publication was a memoir (edited by his son, C. Neumann), 'Beiträge zur Theorie der Kugelfunctionen,' which contains many interesting theoretical researches on that subject.

* Neumann's initials are often incorrectly given; thus, in the text of Maxwell's 'Electricity and Magnetism' (second edition) he is uniformly quoted as J. Neumann.

† In both the problems mentioned the values of the constants are really indeterminate, but the solution gives, under certain assumptions, their most probable values. Care should be taken that in any actual problem the assumptions are really justified.

Neumann's publications are not sufficient to give an adequate idea of his life's work. As a teacher he exerted a wide-spread influence, and the progress of physical science in Germany is largely indebted to the stimulating influence which he exercised, especially with the help of the 'Mathematisch-Physikalisches Seminar,' founded by him in conjunction with Jacobi and Sohnke. The object of this institution was to supplement the teaching given in lectures, and to introduce students into the methods of original research. Exercises were set to the students by the directors of the seminar, and, as Neumann himself explained, "In the choice of problems I laid stress on their referring to points of practical importance, such as the application of Gauss' theory of principal points and planes in a system of lenses; or that the selected exercise should lead students to an experimental investigation of a problem which they had treated in a theoretical manner."

There was never, probably, a school of original research conducted in so systematic a manner as this seminar, in which Neumann was the leading spirit. Annual reports of the work done by each student were sent in to the Prussian Minister of Education, and, occasionally, money prizes were given for a research of special merit. An interesting account of the history of this seminar is contained in a notice of Neumann's life by P. Volkmann.* Its importance may be recognised by the fact that Kirchhoff's first papers on the distribution of electric conductors, and H. Wild's construction of his photometer and polarimeter, figure amongst the direct results of the teaching given in the seminar. Kirchhoff's great powers were soon recognised by Neumann, and when, in the year 1846, Neumann had set as a special prize problem "The determination of the constants on which the intensity of induced currents depends," the prize was awarded to him for a research which contained the first measurement of a resistance in electro-magnetic measure. Neumann's success as a teacher will be appreciated by reference, in Volkmann's publication, to the doctor dissertations of his pupils, which were carried out under his guidance. Amongst the students who flocked to hear his lectures at Königsberg, we find Borchardt, Durège, Lipschitz, Kirchhoff, Wild, C. Neumann, Clebsch, Auwers, Quincke, and Voigt.

Neumann was elected a Foreign Member of the Royal Society in 1862, a Corresponding Member of the French Academy in 1863, and received the Copley Medal in the year 1887.

A. S.

* Leipzig (G. Teubner), 1896. I owe to this publication and to Mr. Voigt's notice in 'Göttingen, Nachrichten,' 1895, p. 248, nearly all the information given in the above obituary notice.

By the death of Sir JOSEPH PRESTWICH British geological science loses one of its oldest, as well as one of its most distinguished votaries. Descended from an old Lancashire family (in which, for some cause or other, a baronetcy has lain dormant for some generations), he was born at Pensbury, Clapham, on March 12, 1812.* After some preliminary schooling he was sent to Paris, where he remained for two years in a school attached to the Collège Bourbon. He was then transferred to Dr. Valpy's, at Reading, and finally entered University College, London, soon after its establishment. He there worked diligently in the chemical and natural philosophy classes under Dr. Turner and Dr. Lardner, availing himself also of the geological and mineralogical collections in the British Museum.

While still at College he started a Society among his fellow students, each member of which had in his turn to deliver a lecture on chemistry or some branch of natural philosophy. This "Zetetical Society" had rooms of its own, and a small laboratory, in Surrey Street, Strand. It consisted of about fourteen members; but its existence was of limited duration. Mr. Prestwich himself was called away from it to join the business of his father, who was a well-known wine merchant in Mark Lane; and he remained closely connected with the house and business for nearly forty years. Happily, his commercial avocations to some degree aided, instead of restricting, his pursuit of geological studies. He had to make frequent visits to France and Belgium, in both of which countries he formed lasting friendships with the leading geologists and palæontologists of the day; and he made himself personally familiar with the actual strata and fossils which they had described. Not only so, but his business among the country connexions of the firm carried him to nearly every part of the United Kingdom, and the hours unclaimed by his engagements were enthusiastically devoted to the study of the local geology of the districts he visited. His comprehensive eye enabled him rapidly to appreciate and to grasp the leading features, topographical and geological, of most of the areas which in those days possessed an exceptional geological interest; and those who in later years had the good fortune to accompany him to such spots were surprised to find how retentive was his memory and how intimate was his acquaintance with every pit, quarry, and rock-section that in any way illustrated the geological problem under consideration.

His first published papers dealt with the fossil-bearing deposits of the neighbourhood of Gamrie, Banffshire—particularly with the strata containing ichthyolites, and with the shell-bearing layers of the Till—and the international character of his geological work was exhibited

* For much that is here said I am indebted to a memoir by Dr. Henry Woodward, F.R.S., published in the 'Geological Magazine,' 1893, p. 242. I have also to thank Professor Lapworth for kind assistance.

by his following paper, on "Les Débris de Mammifères terrestres qui se trouvent dans l'Argile plastique aux Environs d'Épernay." Though written at an earlier date, these memoirs were not published until 1837. He had already, in 1833, become a Fellow of the Geological Society. His memoir on the "Geology of Coalbrookdale," published in the Transactions of that Society in 1836, was founded mainly on visits made to Coalbrookdale in the years 1831 and 1832. This work, which was accompanied by descriptions of new plants and mollusca by his friend Professor Morris, was the earliest monograph on the structure of a British coalfield. It at once established his reputation as a geologist, and it has ever since been numbered among our British classics.

From about 1846 onwards for several years, his attention was mainly concentrated upon the tertiary deposits of the London basin, and he published a work on the water-bearing characters of these deposits in 1851. But the scientific results of his investigations were of far higher importance. He not only reduced the little known English tertiaries into proper system (establishing the separate existence of certain local beds to which he gave the name of the Thanet Sands, proving the synchronism of the Reading beds with those of Woolwich, and fixing the true position of the London clay with respect to the Hampshire basin), but he succeeded in correlating the tertiary beds of England, France, and Belgium in such a manner that his classification was accepted by most geologists, and has stood the test of time.

This comprehensive study of the tertiary group naturally led Mr. Prestwich onward to the investigation of the later and more superficial deposits; and the acquaintance which the writer of these pages had the good fortune to form with him in 1851, led to an enduring friendship and constant intercourse, as well as to occasional geological excursions with him to spots where these drift and alluvial deposits could be examined. In the winter of 1858, Dr. Hugh Falconer urged upon Mr. Prestwich's attention the desirability of investigating in the field the evidences for the discoveries of M. Boucher de Perthes of flint implements of prehistoric man in the gravel deposits of the Valley of the Somme, which were then somewhat doubtfully received, and in April, 1859, Mr. Prestwich proceeded to Abbeville, where he was joined by Mr. John Evans. Thence they went to Amiens, and in the gravel beds of St. Acheul saw for themselves, still embedded in its matrix, one of those implements of unquestionable human workmanship, the asserted existence of which in the alluvial deposits had met with so much doubt. The previous discoveries, thus verified and subsequently supplemented by researches conducted on lines which could with confidence be laid down, soon led to an entire revolution in the then existing ideas as to the antiquity of man. Not that the new views were at

once accepted, or that the advocates of the old ideas were backward in their defence of them. For years controversy was long and occasionally loud; but so completely has it now died out, that the promoters of what were then new views occasionally find themselves at the present time in antagonism with the promoters of views newer still, for which they are not quite satisfied that there is as yet sufficient foundation.

At various intervals, from 1859 onwards, Mr. Prestwich wrote several papers relating to post-Pliocene deposits, including one of great importance, "On the Loess of the Valleys of the South of England and of the Somme and of the Seine," communicated to the Royal Society in 1862. He had previously furnished to the Society an account of the discoveries of flint implements at Abbeville, Amiens, and Hoxne.

In 1866 and 1867 Mr. Prestwich rendered valuable aid to the country by acting on the Royal Coal Commission, and on that on the Metropolitan Water Supply. In connection with the former he furnished an exhaustive, and at the same time suggestive, Report (published in 1871) "On the Probability of finding Coal under the Newer Formations of the South of England"—some of the anticipations in which he lived to see at all events partially realised.

With regard to the latter subject, his book, 'The Water-bearing Strata of the Country around London,' gave evidence of his capacity to speak.

During all these years Mr. Prestwich had been actively engaged in business, and it is amazing to note the amount of detailed and accurate geological work that he was able to accomplish. But about 1872 he managed to emancipate himself in a great measure from the trammels of trade, and in 1874 he was appointed to succeed the late Professor Phillips in the Chair of Geology at Oxford. He was there able to devote nearly the whole of his time to the prosecution of his favourite study, and to enlisting recruits for the science.

It is impossible in a notice of this kind to cite even the titles of his numerous papers, but especial mention may be made of his memoirs "On the Temperature of the Sea at various Depths below the Surface," and "On the Origin of the Parallel Roads of Lochaber" (printed in the 'Philosophical Transactions'), as well as those on "Underground Temperature" and on the evidences of the "Submergence of Western Europe."

To the Institution of Civil Engineers he communicated essays on the "Geological Conditions affecting the Construction of a Tunnel between England and France," and on the "Origin of the Chesil Beach," for which a Telford Medal was awarded him.

His papers read before the Geological Society were numerous. Among his later ones, those on "Volcanic Action," on the "Mundesley

and Westleton Beds," on the "Relation of the Glacial Period to the Antiquity of Man," on the "Pre-glacial Drifts of the South of England," and on the "Age of the Valley of the Darent," may, perhaps, be described as the more important.

It was while living at Oxford that he produced, in 1886 and 1887, his great work in two volumes on "Geology, Chemical and Physical, Stratigraphical and Palæontological." In this work he not only brought forward many arguments against carrying the doctrine of uniformity too far in attempting to read the history of the earth, but at the same time he showed some signs of reverting to theories involving more of cataclysmic action than most modern geologists are willing to allow. As a whole, however, his book is a monument of patient and conscientious work, and is likely long to retain the high position that it holds at present in geological literature.

As already stated, Mr. Prestwich was elected a Fellow of the Geological Society so long ago as 1833. From 1856 onwards he for many years served the Society as Treasurer, becoming President for two years, from 1870 to 1872. Already in 1849 the Wollaston Medal had been awarded him for his researches at Coalbrookdale and in the London Basin.

In 1853 he was elected a Fellow of the Royal Society, and at intervals served upon its Council, during seven years in the aggregate. In 1870—1871 he was a Vice-President of the Society. One of the Royal Medals was awarded to him in 1865 for his contributions to geological science.

In France the name of Prestwich was almost as well known as in England. He was one of the oldest members of the French Geological Society, and when it was assembled at Boulogne, in 1880, he was appointed President of the meeting. In 1885 he was elected a Corresponding Member of the Institut (Académie des Sciences). He was also a Foreign Member of the Accademia dei Lincei, at Rome, of the Geological Institute of Vienna, and of various academies in Belgium, Switzerland, and the United States of America. When the International Geological Congress met at London in 1888, the esteem with which he was regarded by geologists of all nationalities was shown by his unanimous election as President of the Congress.

He retired from the Geological Chair at Oxford in 1888, to the great regret of his brother professors, and of his numerous friends in that University, which conferred upon him in the same year, as a tribute of esteem, the honorary degree of D.C.L. After his retirement he resided for the most part at his delightful country house, Darent Hulme, Shoreham, Kent, which he built, in accordance with his own tastes some twenty-seven years ago, and every room and wall of which brought to mind some subject of geological interest, either in material or decoration. There he actively continued his scientific

labours, efficiently aided and cared for by a loving wife—the niece of his old friend, Dr. Hugh Falconer.

The first public recognition of his services, both to science and the State, was accorded him at the beginning of the present year, when he received the honour of knighthood, with the unanimous acclaim of the scientific world. But he was, alas! not destined to bear his honours long, and, after some months of great physical weakness, he died on June 23rd, 1896.

Of his personal amiability, his devoted friendship, and his charm of manner, this is hardly the place to speak: but all those with whom he was brought into contact will agree that in Sir Joseph Prestwich we have lost not only one of the great pillars of geological science, but a geologist whose mind was as fully stored with accumulated knowledge as that of any of his contemporaries, and one who was always ready to place those stores generously and freely at the disposal of others.

J. E.

George Johnson was born in November, 1818, at Goudhurst, in Kent, and he received his education at the Grammar School there. In 1837 he paid a visit of some weeks to an uncle who was a medical practitioner in Cranbrook, and became so enamoured with the life of a country doctor that he decided to join his uncle as an apprentice. There he remained for two years and a half, and then entered the medical department of King's College, London, with which institution his name has been so intimately connected ever since. His college life was a highly distinguished one; he obtained numerous prizes and scholarships both at the College and at the University of London, where he took his degree of M.D. in 1844. At King's College Hospital he served as clinical clerk to Dr. Todd, and dresser to Sir William Ferguson; later on he became house physician, house surgeon, and, in 1843, resident medical tutor. At the end of his college course he was elected an Associate of King's College.

This brilliant academical career altered his intention of becoming a country practitioner, and he decided to remain in London. In 1846 he became a Member of the Royal College of Physicians, and four years later was elected a Fellow. At the College of Physicians he filled many important offices, including those of Examiner in Medicine, Councillor, Censor, Vice-President, Goulstonian Lecturer, Lumleian Lecturer, and Harveian Orator. In 1862 he was appointed a Senator of the University of London; in 1872 he became a Fellow of the Royal Society; and, in 1884, President of the Royal Medical and Chirurgical Society.

His appointments at King's College Hospital were those of Assistant Physician (1847), Full Physician (1856), Professor of

Materia Medica (1857), and Professor of Medicine, in succession to Dr. George Budd (1863). In 1886 he resigned this post, and was elected by the Council, Emeritus Professor of Clinical Medicine, and Consulting Physician to the Hospital. Shortly after this he became a Member of the Council of King's College, in which position he continued to serve his *alma mater* until his death.

In 1883, Dr. Johnson was appointed by the Prince of Wales Consulting Physician to the Royal College of Music; in 1885 he received the honour of being elected a member of the Athenæum Club, on the ground of his eminence in science; in 1888 his past and present students and friends presented him with his portrait, painted by the late Mr. Frank Holl, R.A. This picture was publicly presented to him in the large theatre of King's College amid a crowd of his former colleagues and friends by Sir Joseph Lister. The scene will long be remembered by all those who heard Sir Joseph Lister's kindly words, and Dr. Johnson's emotional reply. In 1889 he was made Physician Extraordinary to the Queen, and in 1892 he received the honour of knighthood.

The following list comprises his principal contributions to literature :—"On Diseases of the Kidney, their Pathology, Diagnosis, and Treatment" (1852); "Lectures on Bright's Disease" (1873); "Epidemic Diarrhœa and Cholera" (1855); "Notes on Cholera" (1856); "The Laryngoscope" (1864); "A Defence of Harvey as the Discoverer of the Circulation of the Blood" (1884); this was a reply to certain criticisms evoked by his Harveian oration of 1882. In 1887 he published a collection of medical essays and lectures in which many of his former ideas were stated with new force. Sir George Johnson's scientific life was by no means a peaceful one, and led to much controversy; he continued to take part in discussions arising from his work until the very last. In 1894, in a series of letters to the 'Lancet,' he maintained, in opposition to Dr. Pavy, that normal urine contains no sugar, but that the principal reducing substance present is creatinine, a material which he and his son (Mr. G. S. Johnson) very thoroughly investigated. In 1889 he published an essay on "Asphyxia," in which he defended his well-known views against those of his opponents. As late as 1895, a 'History of the Cholera Controversy,' in which Sir George played so prominent a part, appeared from his pen; and in the present year a similar book on 'The Pathology of the Contracted Granular Kidney' completed his long series of publications.

He married, in 1850, Charlotte Elizabeth, youngest daughter of the late Lieutenant White, of Addington. He was left a widower with five children ten years later.

The vigour of Sir George Johnson's mind remained unimpaired to the last, but his bodily health was feeble. He suffered from paralysis

agitans, was subject to insomnia, and was slightly deaf. These infirmities rendered his attendance at public meetings somewhat irregular, but when questions of urgency arose he was always at his post at the Senate of the London University, the Council of King's College, and the meetings of the College of Physicians. During the last three or four years, however, his health had improved, and he was able during his summer holidays to resume his shooting in Scotland, a sport of which he was extremely fond. Only last summer he related with pride how he had brought down a stag at the distance of so many yards. His house in Saville Row contained many trophies of the chase. His sudden end on Wednesday, June 3, 1896, therefore came as a surprise and shock to all his friends. The cause of death was apoplexy. The morning of Monday, June 1, he was in his usual health, and he employed it in writing a paper which was published in the 'Lancet' of June 13, under the appropriate title, "A Last Word on Cholera." This was a brief criticism on Dr. Kenneth Macleod's article on "Cholera," in Dr. Clifford Allbutt's 'System of Medicine.' In the afternoon he went out for his usual drive, and it was on his return that he was seized with hemiplegia. Though he regained sufficient consciousness to recognise those about him, he never rallied, and died within forty-eight hours of the attack.

The funeral took place on June 8, after a preliminary service at St. James's, Piccadilly, conducted by Dr. Wace, Principal of King's College, and attended by a large number of his friends and admirers, Sir Joseph Lister representing the Royal Society; the remains were laid to rest by the side of those of his wife at St. Mary's, Addington.

The medical and scientific world has lost a distinguished ornament, an earnest and steady worker, a deep thinker, a vigorous writer, and a lovable and tender-hearted friend.

The foregoing enumeration of the principal incidents in his life shows how full it was of active service, but cannot paint the man as he was to those who knew him. The readers of his works will see in him the trenchant writer, and the uncompromising but always fair defender of his views. Those who listened to his lectures will remember the well ordered, logical, and clear exposition of his thoughts; here he never allowed his strong but contentious ideas to appear in undue relief when he was teaching his students. His opponents will know him as a hard hitter, but one who was always ready to acknowledge his own mistakes, and who never carried his words into the region of personal attack. It is, however, only those who sat with him by his fireside who can properly realise the generous friend, the lovable disposition, the keen interest he always took in questions of science, and the enthusiasm with which he followed up his theories. It was especially the younger men with whom he

liked thus to show his sympathy, and among his scientific friends he used to say that above all he dearly loved to chat with the physiologists.

It is somewhat difficult for one like the present writer, who only knew Sir George during the last ten years or so of his life, to guess who among his earlier friends had most to do with the formation of his character. Sir George had obviously a strong character of his own, which would have brought him to the front in any walk of life; but to judge by his conversation on the reminiscences of his younger days, it would seem that above all others, Dr. Todd was the one who especially stimulated him in the particular branches he took up. At the time that he was student, Dr. Todd was Professor of Physiology at King's College, and throughout the whole of his subsequent life, Johnson was as diligent a student of physiology as he was of medicine. He knew, in a most surprising way, the contents of modern physiological text-books, especially in relation to the circulation of the blood, his favourite study; and, to show the vigour of his mind, he was intensely interested towards the last in the question of osmotic pressure, a difficult subject which has only recently attained importance to physiologists. He was, however, not merely a student of books, but was practical to the backbone; after the establishment of the physiological laboratory at King's College, during the time Professor Rutherford occupied the chair of physiology, he was a frequent visitor there, and much important work was done at his suggestion then and subsequently. He was an accomplished histologist, and took a keen delight in showing to his friends the specimens by which he believed he had refuted the views of those who disagreed with him. Even in the last week of his life he had commenced experiments on the action of the cilia in the renal tubules of the newt's kidney.

In mentioning his early friends, one must not omit to enumerate Sir Thomas Watson, whom he helped with his celebrated lectures; Sir William Ferguson, Sir William Bowman, and Dr. Bristowe, all of whom Sir George Johnson survived.

The controversies of his life were numerous; there were stormy times at King's College, especially in years now far back; there was the great cholera controversy: in the first years of this, Johnson was most unfairly treated, being branded almost as a quack in the medical journals. He, however, in spite of loss of practice, stuck to his views, and had, in the end of his days, the satisfaction of seeing his evacuant treatment of cholera regarded as a rational one, and in many cases recognised by eminent practitioners as the correct one. Of his *sobriquets*, Johnson preferred to be known as "Cholera Johnson" rather than "Kidney Johnson." His views on the kidney question were direct deductions from physiological knowledge derived

from the discovery of the muscular structure of the arterioles by Henle, and the work of Claude Bernard on vasomotor nerves. His views on the cause of the hypertrophied heart in cases of Bright's disease are now generally regarded as correct. His ideas on asphyxia, which he continued to the last to call by the old-fashioned, but etymologically correct, name, apnœa, formed the subject of another spirited debate; and, in conclusion, one must mention a controversy of another kind, the dispute with Sir William Gull over a point of professional etiquette connected with the "Balham Case." The point was decided in Johnson's favour by the College of Physicians, but the incident left a good deal of bitterness behind it.

Still this long series of struggles did not embitter Johnson's life. He was always able to discuss the matters involved without a trace of ill-feeling, though a mention of any one of them would lead him into a prolonged and forcible exposition of his own views.

In his later essays he was able to write with calmness, and was willing to leave to time the recognition of what was true in the active and full life-work, which he must have known was then drawing to a close.

W. D. H.

Henry Newell Martin was born on July 1, 1848, at Newry, County Down, Ireland. He was the eldest of a family of twelve, his father being at the time a Congregational minister, but afterwards becoming a schoolmaster. Both his parents were Irish, his father coming from South Ireland, and his mother from North Ireland. He received his early education chiefly at home; for though he went to several schools, his stay was not long at any one of them.

Having matriculated at the University of London before he was fully sixteen years of age (an exemption as to age being made in his favour), he became an apprentice to Dr. McDonagh, in the Hampstead Road, London, in the neighbourhood of University College, on the understanding that the performance of the services which might be required of him as apprentice, should not prevent his attending the teaching at the Medical School of the College, and the practice at the hospital. During his career at University College he greatly distinguished himself, taking several medals and prizes, in spite of his time for study being, on account of the above-mentioned duties, less than that of his fellow students. In 1870 he obtained a scholarship at Christ's College, Cambridge; he had, in the summer of that year, conducted at Cambridge a class of Histology for the late Sir G. Humphry. The writer of this notice had about the same time been appointed Prælector of Physiology at Trinity College, and the two went up to Cambridge together in the October of that year. He at once undertook to act as the demonstrator of the

Trinity Prælector, whose right hand he continued to be in every way during the whole of his stay at Cambridge. His energy and talents, and especially his personal qualities, did much to advance and render popular the then growing School of Natural Science in the University. At that time there was, perhaps, a tendency on the part of the undergraduate to depreciate natural and, especially, biological science, and to regard it as something not quite academical. Martin, by his bright ways, won among his fellows sympathy for his line of study, and showed them, by entering into all their pursuits (he became for instance, President of the Union and Captain of the Volunteers) that the natural science student was in no respects inferior to the others.

In Cambridge, as in London, his career was distinguished. He gained the first place in the Natural Science Tripos of 1873, the second place being taken by Francis M. Balfour; at that time the position in the Tripos was determined by the aggregate of marks in all the subjects. While at Cambridge he took the B.Sc. and M.B. London, gaining in the former the scholarship in Zoology; he proceeded later to the D.Sc., being the first to take that degree in Physiology. So soon as, or even before, he had taken his degree, he began to devote some time to research, though that time, owing to the necessity under which he lay of making money by teaching, was limited; his first publication was a little paper of the structure of the olfactory membrane, which appeared in the 'Journal of Anatomy and Physiology' for 1873.

In the summer of 1874 he assisted the Trinity Prælector in introducing into Cambridge the course of Elementary Biology, which the late Professor Huxley had initiated at the Royal College of Science during the preceding year. He subsequently acted as assistant in the same course to Professor Huxley himself. One result of this was that he prepared, under Huxley's supervision, a text-book of the course which, under their names, appeared with the title 'Practical Biology,' and which has since been so largely used.

In 1874 he was made Fellow of his College, and giving himself up with enthusiasm to the development of natural and, especially, of biologic science at the University, was looking forward to a scientific career in England, if not at Cambridge. About that time, however, the Johns Hopkins University at Baltimore was being established, and such was the impression made by Martin upon those with whom he came in contact, among others Dr. Gilman, of Baltimore, that in 1876 he was invited to become the first occupant of the Chair of Biology which had been founded in the Johns Hopkins University. This offer he accepted, and thus nearly the whole of his scientific career was passed in America. He went out prepared to develop in his new home the higher teaching of biologic science, especially that

spirit of research which alone makes teaching "high"; and during the rather less than a score of years which made up his stay at Baltimore, he produced a very marked effect on American science, fully working out the great aim of the University which had adopted him. By himself, or in concert with his pupils, he carried on many important investigations, among which may especially be mentioned those on the excised mammalian heart. He was the first to show that by appropriate methods the excised mammalian heart may be made the subject of prolonged study. One of these researches, namely, that on the "Influence of Temperature," was made the Croonian Lecture of 1883. His various contributions were, in 1895, republished in a collected form by his friends and pupils in America, under the title of "Physiological Papers." He sent out into the States, from among his students, a number of trained physiologists, fired with his own enthusiasm, who are continuing to advance the science, and one of whom has succeeded him at Baltimore. He also found time to write expository works, and his 'Human Body,' 'Briefer Course,' and 'Elementary Course,' deservedly became very popular in the States.

Upon his first appointment he had the charge of the whole subject of animal biology; and since he was himself more distinctly a physiologist, it was almost his first duty to secure or train up a colleague who should devote himself to morphology. Martin early saw the worth of one of his students, W. K. Brooks; to him he gradually entrusted morphological matters, and thus prepared, not only the way for a separate Chair of Zoology, but also the man to fill it.

Martin married in 1879 Mrs. Pegram, the widow of an officer in the Confederate army; but there was no issue, and in 1892 his wife died.

Even before his wife's death his health had begun to give way; and after that event he became so increasingly unfitted for the duties which his own previous exertions had raised to a very great importance, that in 1893 he resigned his post.

After his resignation he returned to this country, for he had never become an American citizen, and was looking forward to being able, with improved health, to labour in physiological investigations, either at his old University or elsewhere in England. But it was not to be. Though he seemed at times to be improving, he had more than one severe attack of illness, and never gained sufficient strength to set really to work. During the past summer he visibly failed, and while he was striving to recover his strength by a stay in the quiet dales of Yorkshire, a sudden hæmorrhage carried him off on October 27, at Burley-in-Wharfedale, Yorkshire.

Having been for so long a stranger to this country, Martin was,

personally, but little known in English scientific circles; in America, however, not in Baltimore only, but in many other parts of the States, especially among the younger physiologists, he has left behind him a memory which will not soon pass away; while those in this country who knew the brightness of his early days will always hold him in affectionate remembrance.

M. F.

Brian Houghton Hodgson, of the Bengal Civil Service, oriental scholar, zoologist, and diplomatist, was born in February, 1800, at Prestbury, Cheshire, and was the eldest son of B. Hodgson, Esq., of Lower Beech, in that county. He belonged to a long-lived family; his father attaining his ninety-second year, and a grandmother and a great-grandmother their ninetieth. He was educated at Dr. Davies' school, Macclesfield, and was, according to the wishes of his great uncle the Bishop of London, and relative the Dean of Carlisle, intended for the Church; but, having no desire for holy orders, at sixteen years old a nomination to the East India College of Haileybury was obtained for him. Pending the passing his preliminary examination at Haileybury, young Hodgson was the guest of Professor Malthus, then preparing the seventh edition of his "Principles of Population," who directed his attention to politics as a career; whilst a casual presentation at the Governor's house to Canning, then President of the Board of Control, who addressed the youth with a brilliant sketch of the career possible to an Indian civilian, fired him with ambition to become a diplomatist, of which his stirring career, at the Court of Nepal, was the fruit. At Haileybury, Hodgson gained high honours in languages and political economy, finally passing out in 1817 as "First of his year." In 1818 he sailed for Calcutta, where he passed a year in the College at Fort William, studying the vernacular, Sanskrit, and Persian, and becoming a proficient in the latter. At Calcutta his health broke down, and, after a severe attack of fever, no choice was left him between abandoning the service or obtaining a hill appointment. The latter—an all but unattainable prize for an untried youth—was, nevertheless, thanks to his early promise, and more to the private influence of powerful friends with the Government, obtained for him, and he was appointed Assistant to the Commissioner of Kumaon, a province of the Western Himalaya ceded by the Nepalese a few years previously.

Fortunately for Hodgson, his chief, G. W. Traill, was a first-rate official, and, equally fortunately, Kumaon was in a condition of disorganisation and savagery that taxed the highest qualities of its new rulers. It was Traill's first duty to obtain the confidence of a people driven into the jungles of all but pathless mountains by the

alternating tyrannies of Affghans and Ghurkas, and who recognised but two classes of beings—themselves and their ghosts; then to introduce the rudiments of justice, and, finally, raise the condition of the people to that of a prosperous British province. It was during his two years' pupilage with Traill that Hodgson commenced his zoological observations and those studies of the aboriginal tribes of India and their languages, which he pursued throughout his career; and, so efficiently did he perform his official duties, that, after two years (in 1820), he found himself unexpectedly promoted to be Assistant to the British Resident at the Court of Nepal. Here, however, a disappointment awaited him. He found the Resident, the Honourable E. Gardner, giving effect to Lord Hastings' wise policy of converting Nepal from a turbulent neighbour into a quiescent, if not friendly, ally of the British power, and this he was doing so effectively that Hodgson found a truce established, and no scope for his ambition as a politician and diplomatist. He accordingly applied to Government for more active employment, and was at once gazetted to the Secretariat of the Persian Department of the Foreign Office, Calcutta, a step towards the highest positions in the service. At Calcutta his health, as before, at once broke down, and he was fortunate in being sent again (in 1824) to Nepal in a subordinate position, awaiting the successorship to the Assistant Residentship, which post had been filled up. This he obtained in the following year, followed by that of Acting Resident on Mr. Gardner's retirement (1829), and Resident in 1833.

It was during the enforced quiescence of Hodgson's first years in Nepal that he undertook the systematic study of Nepalese and Tibetan Buddhist literature, and the collection and description of the vertebrata of the Himalaya. By his courteous treatment of the Lamas of the temples of Katmandu and of the emissaries of the Grand Lama of Lhassa to the Nepal Court, he enlisted their active co-operation in the purchase of MSS., and in procuring copies of others, some dating back to upwards of 1100 years before the Christian era, for which latter purpose he kept a staff of copyists in constant employ. So impressed was the Buddhist hierarchy by his learning and labours, and so great was his reputation, that the Grand Lama of Lhassa himself sent him a copy of their classical scriptures, the Kaghyur and Stangyur, in 347 folio volumes. Subsequently Hodgson procured another copy which he sent to the college at Fort William, and which is now in the library of the Bengal Asiatic Society. Altogether, dating from 1824, he had given upwards of 270 volumes of Sanskrit and Tibetan literature to British institutions, especially to the Indian Government, and 147 to the Société Asiatique de Paris. The receipt of the latter in France, together with copies of his own researches in Buddhism, were, as early as 1837, recognised by the bestowal on him

of the Foreign Fellowship of the above Société, accompanied by the award of a gold medal, inscribed "Au fondateur de la véritable Étude du Budhisme par les textes et les monuments." This was followed, in 1838, by the Cross of the Legion of Honour, and, in 1844, by his election as a Correspondent of the Institute of France. Meanwhile his contributions to his own Government lay unheeded in the cellars of the old India House in Leadenhall Street; and there they remained till their transference to the present India Office, where the Kaghyur and Stangyur* occupy an apartment to themselves, accessible to all.

Scarcely less valuable and as extensive were Hodgson's contribution to zoology, especially ornithology, which rival his Buddhistical attainments. Throughout his residence in the Himalaya he was himself an assiduous collector, besides keeping a staff of shooters who penetrated even into Tibet, and of stuffers and artists at the Residency. He described systematically and minutely almost every species which he procured, accompanying the descriptions with anatomical details, and observations on their habits, nidification (if of birds), and geographical distribution. He published 127 zoological papers, chiefly in the 'Journal of the Asiatic Society of Bengal.' In 1843 and 1858 he placed 9512 specimens of Himalayan birds, 9037 of mammals, and 84 of reptiles at the disposal of the British Museum, together with 1853 drawings. Of the above the duplicates were distributed to the chief museums of Europe and America.

Very early in his career, Hodgson commenced a study of the Non-Aryan Races of India, their origin, customs, their unwritten languages, which he reduced to writing, their religions and geographical distribution. The results are embodied in twenty-seven papers contributed (with one exception) to the 'Journal of the Asiatic Society of Bengal.' These, in the opinion of Latham and other scholars, are of the highest value and rank as his chief services to literature.

Mr. Hodgson was a zealous advocate of the employment of the vernacular for instruction in the primary schools of India. In this his great opponents were Macaulay, Sir L. Trevelyan, and H. H. Wilson, who advocated English or a classical Oriental tongue. In 1835 he published two letters on the state of Education in India, which first "lifted the subject out of the arena of public controversy." For twenty years he persisted in his efforts, which were not crowned with success till 1854, when the Court of Directors adopted his views, which were further confirmed by the Education Commission of 1882.

But diplomacy was Hodgson's earliest and abiding ambition, and

* For a very imperfect copy of these works the Russian Government lately paid £2000.

for the exercise of this he had ample scope during the ten years of his residence at the Nepal Court. The latter, never friendly to the British alliance, was distracted by the often murderous intrigues of Raja, princes, queens, ministers, and a dominant military class of aggressive disposition, and Hodgson's main efforts were directed to the establishment of trading relations with Nepal, and to warding off or rendering abortive measures that would have led to hostilities with the Company's forces, especially during the crises of the Chinese, Affghan, and Punjab Wars. He persistently advocated the policy of enlisting the fighting class of Nepal in the British Army as a safe outlet for its activity, and it was greatly due to his influence with his friend Jung Bahadur, and his representations to Lord Canning, then Governor-General, that the former placed a Ghurka force at our disposal during the Mutiny.

In 1843 Mr. Hodgson retired from the service, and after a year's visit to England, and disposing of his later collections, he returned to India with the intention of pursuing chiefly his ethnological studies. For this object he took up his residence at Darjiling, a recently created health resort, nearly 7500 ft. above the sea, in the unexplored Himalaya, east of Nepal. Here he resided for sixteen years, in indifferent health, the result of repeated fevers in Nepal, but as indefatigable as ever in collecting and publishing in continuation of his Buddhist, zoological, and ethnological work, and in furtherance of the adoption of vernacular education.

In 1858 he finally returned to England, and resided first at the Rangers, Dursley, in Gloucestershire, whence he removed in 1867 to the Grange, Alderley, in the same county, frequently visiting London during the summer months. Latterly, the winters were passed at the Villa Himalaya, Mentone. He married first, in 1863, Miss Anne Scott, daughter of General H. A. Scott, R.A.; and, in 1868, Susan, daughter of the Rev. Chambre Townshend, of Derry, Cork, who survives him. He was elected a Fellow of the Linnean Society in 1835, and of the Royal in 1877; Corresponding Member of the Royal Asiatic Society in 1828, and Vice-President in 1876; Correspondent of the Zoological Society in 1859; D.C.L. (Oxon.) in 1889; and Fellow or Correspondent of many other scientific and literary bodies. The honours so early showered on him by France are given above. In person Mr. Hodgson was very good-looking, and of singularly frank and courteous bearing, communicative, and generous to a fault. His was a remarkable case not only of inherited longevity, but of complete recovery in after life from the effects of long-continued and often serious indisposition in India. He was fond of out-of-door exercise, and hunted till disabled by accident at sixty-eight. He retained his faculties but little impaired till his death in the summer of 1894, leaving no family. He was buried at Alderley.

J. D. H.

William Crawford Williamson was born at Scarborough, on November 24, 1816. His father, John Williamson, who began life as a gardener, was a man of considerable scientific attainments, and was, for twenty-seven years, curator of the Scarborough Museum. From him his son early acquired a practical knowledge of geology and natural history. Williamson, in his recently published autobiography,* describes how, when a boy, his evenings, throughout a long winter, were devoted to naming fossil specimens from the neighbouring coast, with the aid of Phillips' 'Geology of Yorkshire.' "Pursuing," he says, "this uncongenial labour, gave me in my thirteenth year a thorough practical familiarity with the palæontological treasures of Eastern Yorkshire. This early acquisition happily moulded the entire course of my future life."

Williamson in those early days came into contact with several distinguished men of science, and, notably, with William Smith, the father of English geology, who spent two years in the Williamsons' house.

A little later, in 1832, he made the acquaintance of Murchison, who was already a friend of his father's, and from whom the younger Williamson received great kindness.

Williamson early adopted the medical profession, and during his apprenticeship to a Scarborough apothecary, found time to carry on his work in natural history, spending his holidays in shooting rare birds, and collecting plants and fossils. He wrote a paper on rare Yorkshire birds, when only about 16, and almost immediately afterwards he made his first contributions to fossil botany, drawing and describing many of the specimens for Lindley and Hutton's 'Fossil Flora of Great Britain.' More than thirty of the plates in this well-known book bear his name.

A paper on the distribution of organic remains in the Lias series of Yorkshire was read before the Geological Society of London, on May 9, 1834, when the author had only attained the age of $17\frac{1}{2}$, and another in November, 1836, on the Oolitic fossils of the same coast. These were remarkable contributions to science in themselves, and the more so as coming from so young a worker; few naturalists can have started serious investigation so early in life.

Before he was 18, Williamson appeared as an author on a very different subject, for, in 1834, he published an account of the excavation of a tumulus at Gristhorpe, near Scarborough. This, which was probably his only archæological publication, was important in its effect on his scientific career, inasmuch as it brought the young naturalist into communication with the distinguished geologist, Dr. Buckland. Through his influence, this paper was reproduced in the

* 'Reminiscences of a Yorkshire Naturalist,' by W. C. Williamson, Redway, 1896.

Literary Gazette.' In a letter to Williamson, referring to this, Dr. Buckland said, "I am happy to have been instrumental in bringing before the public a name to which I look forward as likely to figure in the annals of British science." "The letter of Dr. Buckland," says Williamson, "was one of those influences the effect of which was unmitigatedly healthy."*

In 1835 Williamson was appointed curator of the museum of the Natural History Society at Manchester, an office which he held for three years while pursuing his medical studies. Several papers, chiefly on geological subjects, were the fruit of this period. In 1840 Williamson left Manchester and came up to London, where he entered as a student at University College. He here attended the lectures of the botanist Lindley, who now for the first time made the personal acquaintance of his young coadjutor.

While in London he was offered the post of naturalist to an expedition up the Niger, an offer which, fortunately for him and for science, he declined, for the undertaking ended disastrously.

After about a year's work in London, Williamson passed his qualifying examinations at the Apothecaries' Hall and College of Surgeons, and then returned to Manchester, where he at once commenced the practice of medicine. At first he found it necessary to keep his scientific pursuits somewhat in the background, but this did not last long. His interest in Ehrenberg's discovery of the Foraminifera in chalk led him to undertake microscopic research, a field of inquiry on which he had not previously entered. His first histological investigation, in 1842, related to the development of bone, a subject to which he returned a few years later. In the meantime he engaged seriously in the study of Foraminifera, following up Ehrenberg's work above referred to. Among the naturalists who supplied him with material for this investigation was Charles Darwin, then just returned from his famous voyage in the "Beagle." The results of Williamson's studies were embodied in a paper published in the 'Transactions of the Literary and Philosophical Society of Manchester' for 1845, on "Some Microscopical Objects found in the Mud of the Levant and other Deposits, with Remarks on the mode of Formation of Calcareous and Infusorial Siliceous Rocks." This was the most important of his works up to that date, and helped to lay the foundation of our knowledge of the part played by Foraminifera in the formation of geological deposits.

Williamson continued the study of these minute organisms, confirming the conclusions of Dujardin as to their affinities, and demonstrating the great variability of the living species. Many years later, in 1857, he completed his monograph for the Ray Society on the

* 'Reminiscences of a Yorkshire Naturalist,' page 47.

recent Foraminifera of Great Britain, after publishing a number of shorter memoirs on the group.

In 1851–2 Williamson made a careful study of the organisation of *Volvox Globator*, and brought out facts as to the mode of connection between its cells, which have only been verified by other observers within the last few years. This was probably his best contribution to recent botany.

Shortly before this date Williamson had undertaken an investigation of a totally different kind, namely, the development of the teeth and bones of fishes, which he considered in relation to the cell theory. His results in this field were of great importance, and are embodied in two papers published in the 'Philosophical Transactions of the Royal Society' for 1849 and 1851. The value of these investigations was recognised by his election as a Fellow of the Royal Society in 1854.

Previously to this, in January, 1851, Williamson had entered the ranks of official teachers of Science, by his appointment as Professor of Natural History in the newly founded Owens College at Manchester. This was an arduous post, for the subjects to be taught included three sciences: zoology, botany, and geology. At first he found it possible to deal with this formidable task, by spreading his complete course over two years, a wise arrangement under the circumstances, but one which the exigencies of the examination system ultimately rendered impracticable. This led in 1872 to a division of the duties of the chair, Williamson being then relieved of the geological part of the teaching by Professor Boyd Dawkins. The remaining work, however, was still far too extensive for any one teacher, and in 1880 a further division of labour took place. The late Professor Milnes Marshall occupied the chair of zoology, while Williamson retained that of botany, which he continued to hold till 1892.

In addition to his strictly official work as Professor, Williamson was one of the first two members of the staff, who, as early as 1854, started evening classes for working men. In later years, he met with extraordinary success as a popular scientific lecturer, more especially for the Gilchrist Trustees, for whom he delivered some hundreds of lectures during the period from 1874 to 1890. His power of rousing and retaining the interest of great popular audiences is described by those who have heard him as most remarkable.

During a great part of the time at Owens College, Williamson continued in active and successful practice as a physician. In the midst of all his multifarious duties, as professor, popular lecturer, and medical practitioner, he always found time for original scientific work; rarely has so busy a man done so much for the advancement of science by actual research.

So far, little has been said of the work of Williamson on fossil

botany, the subject with which his name is now most intimately associated, as it occupied all the latter part of his career as an investigator. His interest in such matters goes back, as has been mentioned above, to the very beginning of his scientific life. In addition to his work for Lindley and Hutton, a paper of his on the origin of coal was read before the British Association as early as 1842. His first original contribution to fossil botany dates from the year 1851, when he published a paper "On the Structure and Affinities of the Plants hitherto known as Sternbergiæ," in which he demonstrated their true nature as casts of the pith-cavity of Gymnospermous trees. A few years later, in 1854–5, he published papers on what was then called *Zamia gigas*, an extraordinary oolitic fossil, which Williamson believed to have Cycadean affinities, a view which has since been so far confirmed that the fossil is now regarded as representing the fructification of one the Bennettiteæ, an allied, though very different family. Williamson's full memoir on the subject was written soon after 1855, but, owing to a succession of misfortunes, its appearance was long delayed, and it only saw the light in the 'Linnean Society's Transactions' for 1868, when it was published simultaneously with Mr. Carruthers' well-known paper on fossil Cycadean stems. The latter author founded a new genus for *Zamia gigas* under the name of *Williamsonia*.

Williamson's really characteristic work in fossil botany consisted in the investigation of the histological structure of carboniferous plants. The first beginning was made with the paper on *Sternbergia*, but it was not till long afterwards that the long series of publications began, which have done more than the works of any other writer to make us acquainted with the organisation of Palæozoic plants. It was early in the fifties that Williamson made his first sections, but not till 1868 that, in consequence of a correspondence with the French palæobotanist, Grand'Eury, he published the result of his investigations in the paper "On the Structure of the Woody Zone of an undescribed Form of Calamite," 'Manchester Literary and Philosophical Society's Proceedings,' Ser. 3, vol. 4. From that period onwards, his whole time available for original research was devoted to the Carboniferous Flora, and a magnificent series of memoirs was the result, which will always rank among the classics of fossil botany. The Royal Society alone published in the 'Philosophical Transactions' nineteen memoirs from his hand, their dates ranging from 1871 to 1893, and, besides these, many valuable papers appeared elsewhere, notably the memoir on *Stigmaria ficoides*, published in 1886, by the Palæontographical Society. It is impossible here to attempt anything like a summary of this great work, which threw light on every department of Palæozoic botany.*

* For fuller information see Williamson's 'Reminiscences,' especially chap. 13;

Perhaps the greatest result was his demonstration, after a controversy extending over a quarter of a century, that the Sigillarian and Calamarian trees of the Carboniferous period were Cryptogams. To use his own words: "The fight was always the same: Was Brongniart right or wrong, when he uttered his dogma, that if the stem of a fossil plant contained a secondary growth of wood, the product of a cambium layer, it could not possibly belong to the cryptogamic division of the vegetable kingdom?" Williamson ultimately succeeded in convincing his opponents, including almost all the members even of the French school, that the plants in question are nothing but highly organised Cryptogams, their secondary growth being mainly an adaptation to arborescent habit, and by no means an indication of Phanerogamic affinities. In this controversy Williamson had two sets of opponents; namely, those who followed Brongniart in regarding plants with secondary growth as necessarily phanerogamic, and those who, while recognising the cryptogamic nature of the plants under discussion, denied or minimised the secondary growth itself. Williamson, in spite of occasional mistakes in detail, was ultimately victorious on both issues; there is to-day, not the slightest doubt that most Palæozoic Cryptogams formed, by means of cambium, secondary tissues essentially similar to those of Dicotyledons or Gymnosperms, and that these plants were none the less as truly cryptogamic as their less highly organised representatives at the present day.

But, apart from this controversy, upon which it is superfluous to dwell longer, Williamson advanced our knowledge of the ancient plants in many directions, especially as regards the Sphenophylleæ, of which he discovered the first fructifications showing structure; the fructifications of Calamarieæ and Lepidodendreæ; the various types of structure among the fossil Lycopods; the existence of a group on the frontier of Ferns and Cycads, &c. He made mistakes, as all do, who carry out extensive investigations in a new field, but he corrected most of them himself, and they in no way affect the permanent value of his great work in laying the secure foundations of scientific palæozoic botany.

Williamson's remarkable skill as a draughtsman added greatly to the value of his memoirs, which are illustrated almost wholly by his own hand. He was by nature an artist, and, in addition to his scientific drawings, painted many pleasing landscapes in water-colours during his leisure hours.

Williamson was an all-round naturalist of a type now unhappily all but extinct. He made his mark as a distinguished original

the obituary notice by Solms-Laubach, in 'Nature' for September 5, 1895; and D. H. Scott, "Williamson's Researches on the Carboniferous Flora," 'Science Progress,' December, 1895.

investigator in three distinct sciences; in geology, by his early work on zonal distribution of the fossils on the Yorkshire coast, and again by his investigations of the Foraminifera of marine deposits; in zoology, by his researches on the development of the teeth and bones, not to mention his work on recent Foraminifera and Rotifera; in botany, by his elucidation of the structure of fossil plants. It would be difficult to find another example from our own time of equally varied and successful scientific activity.

His ability was recognised by competent men of science from his early youth upwards, and during all the earlier part of his career his work was of an advanced type, and up to the best standard of the day. At a later period, especially during his investigations of the Carboniferous Flora, this was no longer the case in an equal degree. Owing chiefly, perhaps, to his want of knowledge of German, his later publications suffered somewhat from his insufficient familiarity with the results of modern botanical work, and with the consequent technical expressions. This makes some of his writings hard to follow, and has led to their being estimated below their true value by some botanists of a more modern school, who have sometimes failed to appreciate discoveries, however important, unless recorded in the current vernacular of modern science. Those, however, who take the trouble to surmount this initial difficulty, will always be astonished at the wealth of observation which his work contains, and at the sound judgment which he brought to bear on his discoveries.

After his retirement from official duties in 1892, Williamson spent the last three years of his life near London in peaceful devotion to his favourite studies, continuing his scientific researches to the last. His death took place at his house at Clapham Common, on June 23, 1895, at the age of 78.

His unique collection of slides, illustrating the microscopical structure of fossil plants, has happily been acquired by the British Museum (Natural History Department).

Williamson received various marks of public recognition during his long career. A Royal medal was awarded to him in 1874 for his researches on fossil plants, at a time when he had only published six out of his nineteen memoirs in the 'Philosophical Transactions'; in 1890 he received the Wollaston medal of the Geological Society; he was a foreign member of the Göttingen Academy of Sciences, and of the Royal Society of Sweden; in 1883, the University of Edinburgh conferred upon him the degree of LL.D.

D. H. S.

Admiral Sir George Henry Richards, K.C.B. This officer, the son of Captain G. S. Richards, R.N., was born in 1820, and entered the Royal Navy, on board the "Rhadamanthus," in 1833, and served

in her in the West Indies for two years under the late Admiral G. Graves. In 1835 he was appointed midshipman in an expedition consisting of the "Sulphur" and "Starling," fitting out under the late Admiral F. W. Beechey, for exploration and survey in the Pacific. He served for five years in the "Sulphur," chiefly under Sir Edward Belcher, on the surveys of the West Coasts of South and North America, the Pacific Islands, New Guinea, and the Moluccas, and was then transferred as Senior Executive Officer to the "Starling," Captain Kellett. He was present in her during the first Chinese War at the taking of the Bogne forts and the capture of Canton. The ship returned to England in 1842.

After three months in the "Caledonia," under the flag of Sir David Milne, he was, on July 12, 1842, promoted to Lieutenant, and appointed to the "Philomel," fitting for the survey of the Falkland Islands, under Captain Bartholomew Sulivan. The "Philomel" was, however, diverted from this survey to take part in the operations against Rosas, the President of the Republic of Buenos Ayres, in 1845–46. Lieutenant Richards was present at the different actions in the Parana and the Uruguay, and commanded the boats of the "Philomel" at the cutting out of a schooner at night under a heavy fire of musketry from the banks of the Uruguay, and received the thanks of the senior officer, Sir C. Hotham, on the quarter deck of the "Gorgon."

He was senior lieutenant at the attack of the forts at Obligado in the Parana on November 18, 1845, and commanded the small-arm men of the "Philomel" at the storming of the batteries and capture of the guns which were taken on board the ships. On his return to England, in June, 1846, he was promoted to Commander from the date of the action.

In 1847 he was appointed to the "Acheron," Captain J. Lort Stokes, destined for the survey of New Zealand, and was employed for four years on this service. The existing charts of this colony are mainly the result of this survey.

Returning home, in 1852, Commander Richards volunteered for, and was immediately appointed to, an expedition fitting out for the Arctic Regions to continue the search for the missing ships of Sir John Franklin, and in April of that year sailed as Commander of the "Assistance," and second to Sir Edward Belcher in the Wellington Channel division of the squadron.

Whilst on this service he conducted several extended sledging expeditions, travelling more than 2,000 miles over the frozen sea, mapping many unknown coasts, and being absent from the ships on such duty for a period of, on the whole, seven months. Commander Richards' unvarying good humour and good fellowship did much to render this expedition a success under very trying circumstances.

On his return to England in the autumn of 1854 he was promoted to the rank of Captain, and was not again employed till 1856, when he was appointed to the command of the "Plumper," in charge of the survey of Vancouver Island and the coasts of British Columbia. He was at the same time nominated a Queen's Commissioner conjointly with Captain Prevost, R.N., for settling the Oregon boundary question between Great Britain and the United States.

Captain Richards settled the point on the coast from which the boundary line should start, and rendered efficient aid to the combined party of Royal Engineers and others who traced it to the eastward.

In the "Plumper," and subsequently in the "Hecate," he conducted for seven years the surveys of the intricate and rock-studded coasts and channels of Vancouver and British Columbia, accomplishing a marvellous amount of work. He returned to England in 1863 by the islands of the Western Pacific, Australia, and Torres Straits, making surveys and fixing longitudes on the way. This voyage completed his third circumnavigation of the globe.

He arrived in England to find himself appointed Hydrographer of the Admiralty, the late occupant of the post, Admiral Washington, having recently died.

Captain Richards held this post for 10 years, and by his powers of organisation, and the most unremitting industry, greatly increased the efficiency of his department, which he administered with great skill, and placed upon a firm basis to meet its ever growing work.

A new scheme of retirement placed Richards, who had attained the rank of Rear-Admiral on June 2, 1870, on the retired list in 1874, when he left the Admiralty.

Whilst Hydrographer he did all in his power to further scientific exploration of the sea. The preliminary voyages made by Dr. Carpenter, Mr. Gwyn Jeffreys, and Dr. Wyville Thomson in the "Porcupine," "Lightning," and other of H.M. surveying vessels in 1868–71 were promoted by him, and led up to the ever memorable expedition of the "Challenger" in 1872, in the inception of which he played a very important part, whilst its fitting out and organisation were carried out under his superintendence.

He also made the preliminary arrangements for the transport of the expeditions for the observation of the Transit of Venus in 1874, which were carried out shortly after he relinquished office.

In 1866 Richards was elected a Fellow of the Royal Society, and in the same year a Corresponding Member of the Academy of Sciences of Paris. He was also an active member of the Royal Geographical Society, serving on the Council.

In 1869 he was nominated an A.D.C. to the Queen, and in 1871 a Companion of the Bath. He received the honour of knighthood in

1877, and in 1888 the Knight Commandership of the Military Division of the Bath.

Admiral Richards was, while serving at the Admiralty and subsequently, a trusted adviser of several administrations, and was a member of several committees on confidential and general subjects, and was also President of the Arctic Committee which sat in 1875.

He became a Vice-Admiral in 1877, and Admiral in 1884.

After leaving the Admiralty he was at once offered and accepted the position of Managing Director of the Telegraph Construction and Maintenance Company, which he held for twenty years, when he was elected Chairman of the Company, a post he occupied to his death.

Whilst Managing Director, some 76,000 miles of submarine cables were laid under his superintendence in different parts of the world.

He was also Acting Conservator of the Mersey from the year 1888, an important post in connection with the well-being of that great seaport.

Sir George Richards served several times on the Council of the Royal Society, and was nominated a Vice-President.

He was a man of great ability, of sound common-sense, and of untiring activity, and his unfailing good humour, general shrewdness, and kindness to younger members of his profession caused him to be universally beloved and respected.

He died at Bath on November 14, 1896, somewhat suddenly, though after a painful period of severe sciatica.

Sir G. Richards married, first, in 1847, Mary, a daughter of Captain R. Young, R.E., by whom he had several sons and daughters; and, secondly, Alice Mary, daughter of the Rev. R. S. Tabor, of Cheam, who survives him.

W. J. L. W.